



## INL engineer leverages research for doctorate degree, awards

By [Keith Arterburn](#), INL Communications & Governmental Affairs

For a young electrical engineer, combining a passion for research with the exhilaration of pursuing a life-long goal of getting a doctorate and winning an international award makes life stimulating, rewarding and fun.

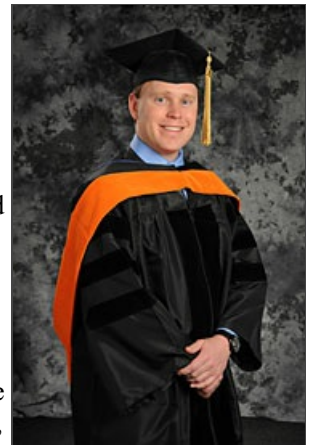
"This has been a very exciting time for me," said Idaho National Laboratory engineer Jon Christophersen, who received his doctorate in electrical engineering from Montana State University in May 2011. "I could not have imagined participating with an award-winning team in solving a major electrical engineering challenge, while at the same time earning my doctorate."

Christophersen collaborated with research team members from academia and industry to invent a hardware-software solution called the Impedance Measurement Box (IMB) that won the [R&D 100 Award](#) in June 2011 and the 2011 Federal Laboratory Consortium Far West competition for Outstanding Technology Development. IMB rapidly measures the impedance in a battery while it is operating. This has never been achieved before and offers the capability to both assess battery health and the opportunity to establish a new standard for energy storage devices.

In solving this engineering challenge, IMB offers the electrical industry a new tool that can be used to better analyze energy storage systems and improve electrical operations. It has significant application in nearly all battery markets, including electrified transportation in which INL conducts major testing of standards for automakers.

The impact of IMB could be felt quickly as the U.S. military uses equipment requiring more than 500 different batteries, Americans purchase three billion batteries each year and more than 14 million hybrid cars are expected to be sold by 2020. IMB also has been nominated for an award in the 2011 technology competition for the [Federal Laboratory Consortium Far West](#) division.

"My 11 years at Idaho National Laboratory has offered me exceptional engineering experience in both hands on research and academic development," Christophersen added. "My managers, mentors and colleagues have encouraged and supported me throughout the busy time of researching and writing my dissertation on the IMB invention."



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***Jon Christophersen, left, runs a test of the Impedance Measure Box with his mentor John Morrison.***

"Winning the R&D 100 Award this year is special recognition for Jon, who is a talented and enthusiastic young engineer," said Timothy Murphy, manager for INL's Energy Storage and Transportation Systems department. "He has a promising future in research and we are gratified that his academic pursuits could complement his work here at INL."

Christophersen, 33, received his bachelors and masters degrees in electrical engineering from the University of Idaho in 1999 and 2005, respectively.

"I very much appreciate the financial and encouraging support from INL in pursuing my doctorate," Christophersen said. "I also want to thank my mentor, Dr. John L. Morrison, for his guidance and nurturing manner during this frenzied time of working on courses, writing a dissertation and developing the IMB with our team." Morrison is a former INL researcher and currently teaches at Montana Tech of the University of Montana.

IMB is a focused advancement addressing impedance measurement and also is a key technology for a more far-reaching research effort. The research team is collaborating on the development of an Energy Storage Monitoring System (ESMS), which will provide reliable and more accurate state-of-health assessments for multiple industries.

Joining INL in 2000, Christophersen has lead responsibilities for developing new diagnostic analysis techniques for energy storage device technologies (e.g., batteries), investigating and implementing novel test profiles and procedures, as well as developing and validating various life-predictive modeling and prognostic tools. He has authored or co-authored more than 15 peer-reviewed journal publications. He also has one

patent, several patents pending and numerous conference proceedings papers and presentations related to energy storage.

Find more information about [Impedance Measurement Box](#) and watch the video.

[Feature Archive](#)